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CASE REPORT

Respiratory-like movements during an apnea test

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Abstract

Background: Despite the possible occurrence of spontaneous movements during an apnea test, respiratory-like movements are rare.

Case Presentation: A 51-year-old man was transferred to our hospital when a sudden disturbance of consciousness developed into cardiac arrest. After spontaneous circulation returned, we diagnosed bilateral cerebellar hemorrhage. He remained comatose with dilated pupils, absent brainstem reflexes, spontaneous breathing, and electrocerebral activity. After being considered brain dead, his family opted for organ donation. The first legal brain death examination on day 5 was aborted because of respiratory-like movements mimicking repetitive abdominal respiration during the apnea test. However, an enhanced magnetic resonance image of the head indicated no blood flow and somatosensory evoked potential testing revealed no brain-derived potentials.

Conclusion: Respiratory-like movements can occur during the apnea test in patients considered brain dead. Further research is required to understand this phenomenon.

KEYWORDS
apnea test, brain death, respiratory-like movement

INTRODUCTION

In numerous countries, confirmation of the absence of breathing drive in the apnea test is mandatory for legal brain death determination, which is aborted in case of spontaneous movements.[1–3] The most recent guideline stated that spinal reflexes do not invalidate the diagnosis of brain death. However, it remains challenging to determine whether reflexes are spinally or cerebrally mediated.[3] Although previous reports described spontaneous movements during the apnea test,[4–6] only a few publications described respiratory-like movements.[5–7] Here, we present a video report of a patient who presented respiratory-like movements during an apnea test required for legal brain death assessment.

CASE PRESENTATION

A 51-year-old man was transferred to our hospital because of disturbed consciousness after he suddenly developed headache and vomiting. His medical history included hypertension, diabetes mellitus, and dyslipidemia. When emergency medical services arrived at the scene, his consciousness level was a Glasgow coma scale of 3; although his blood pressure could not be measured, his carotid artery pulsation was palpable. During transport to the hospital, he suffered cardiac arrest and cardiopulmonary resuscitation was immediately provided. On arrival to our emergency department, he was still in cardiac arrest. He was intubated and administered 1 mg of adrenaline, after which spontaneous circulation returned. Cardiopulmonary resuscitation took 13 min. A computed tomography scan of the head indicated bilateral massive cerebellar hemorrhage accompanied by upward transtentorial herniation of the posterior fossa (Figure 1). He was in a deep coma, and his pupils were 6 mm in diameter bilaterally. As all the examined brainstem reflexes were absent, surgical intervention was not indicated. In the intensive care unit, he was comatose with dilated pupils and no spontaneous breathing was observed. He lacked

brainstem reflexes, and electrocerebral inactivity was confirmed on electroencephalography on day 3. Accordingly, he was considered brain dead. His family decided for organ donation. Thus, on day 5, a first legal brain death judgment was performed. After confirming the presence of a deep coma, bilateral pupil dilation, absence of brainstem reflexes, and flat electroencephalography, an apnea test was performed by administering 6 L/min of oxygen via an aspiration tube in the trachea. One minute after beginning the test, respiratory-like movements were observed, which were identified as abdominal breathing (Video S1). This resulted in discontinuation of the apnea test. On day 9, after obtaining informed consent from his family, enhanced magnetic resonance imaging (MRI) of the head and somatosensory evoked potential (SSEP) testing were performed. The MRI indicated no intracranial blood flow and SSEP showed potentials at N9 and N11, but not after N13, indicating no brain responses either from the medulla oblongata (Figure 2). Finally, the family refused organ donation, and he died on day 20.

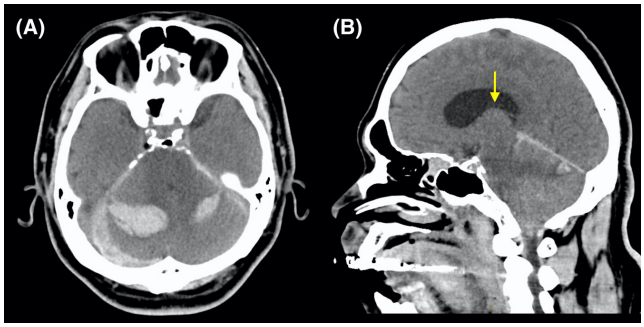

FIGURE 1 Computed tomography image of the head on admission showing (A) bilateral cerebellar hemorrhage and (B) ascending herniation of the brainstem (yellow arrow).

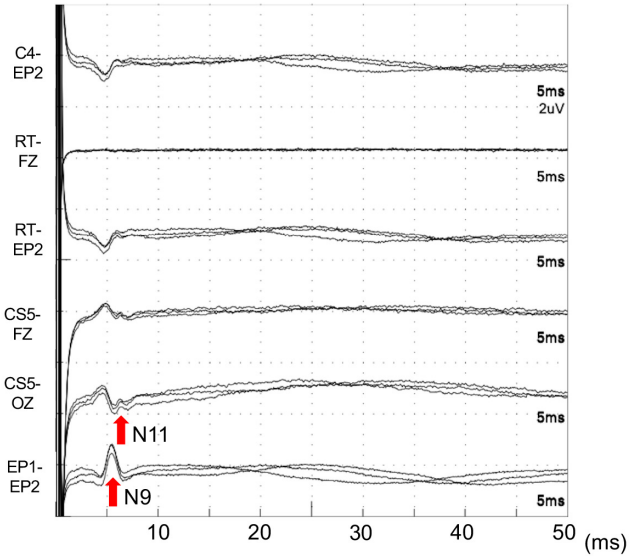

FIGURE 2 SSEP showed potentials at N9 and N11 but not after N13, indicating the lack of brain stem responses.

DISCUSSION

This patient presented with respiratory-like movements during an apnea test performed after confirming deep coma, dilated and fixed pupils, loss of seven brainstem reflexes, and flat brain waves for legal brain death determination. At the time of the apnea test, he was clinically brain dead for 5 days; further tests performed after brain death determination including enhanced MRI and SSEP indicated no blood flow or electrically evoked responses in the brainstem, respectively.

Spontaneous movements such as flexing elbows and holding hands together (known as the Lazarus' sign), jerking of the upper extremities, and eye opening have been described in brain dead patients.[4–6] In a prospective observational study in Korea, reflex or spontaneous movements were observed in 17% of brain dead patients.[5] Further, Urasaki et al.[6] presented a case who showed respiratory-like movements during the apnea test. This patient was in a deep coma due to severe subarachnoid and ventricular hemorrhage. Despite findings being consistent with brain death, including a flat line electroencephalogram and no response in the auditory brainstem response test or SSEP, she presented respiratory-like movements during the apnea test. Similarly, in 51 apnea tests from 36 patients who fulfilled conventional criteria for brain death, three patients showed respiratory-like movements: thoracic movements with an abnormal appearance and ineffective ventilation.[7] For two of them, autopsies within 48 h showed the typical pathological changes of brain death.

Previous researches indicated that respiratory-like movements in brain dead patients could be caused by spinal reflexes.[8,9] In an animal model, Aoki et al. reported spontaneous rhythmic breathing in cats whose first cervical cord was transected, but not in those with third cervical cord transection.[8] Electromyograms of the diaphragm demonstrated that the respiratory movements were mainly due to rhythmic diaphragmatic contraction, indicating that the high cervical cord can generate respiratory activity. Further, in a study using dogs whose spinal cords were transected at either the first or second cervical cord, spinal rhythmic respiratory activity occurred spontaneously or with doxapram administration.[9] This study indicated that the phrenic nerve and the diaphragm play a major role in spinal respiratory activity. Altogether, these studies indicate an association between respiratory-like diaphragmatic movements and cervical spinal activity. Therefore, the respiratory-like movements observed during the apnea test in our patient could be a spinal reflex. However, precise distinction of respiratory-like movements from spontaneous breathing remains unresolved.[3]

CONCLUSION

Respiratory-like movements can occur during the apnea test in patients considered to be brain dead. This phenomenon

may be associated with cervical spinal activity. Further investigation is warranted to clarify this possibility.

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CONFLICT OF INTEREST STATEMENT
The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT
Data sharing is not applicable to this article as no new data were created or analyzed in this study.

ETHICS STATEMENT
Approval of research protocol: N/A.
Informed consent: Published with written consent of the patient's family.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.

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SUPPORTING INFORMATION
Additional supporting information can be found online in the Supporting Information section at the end of this article.

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